FIG. 1

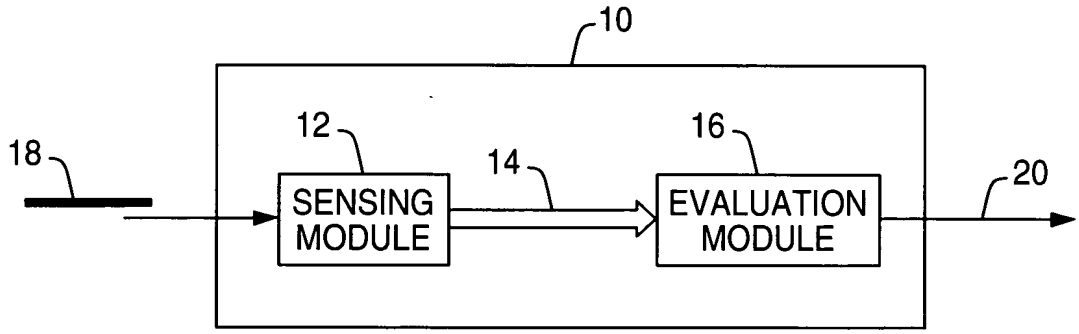
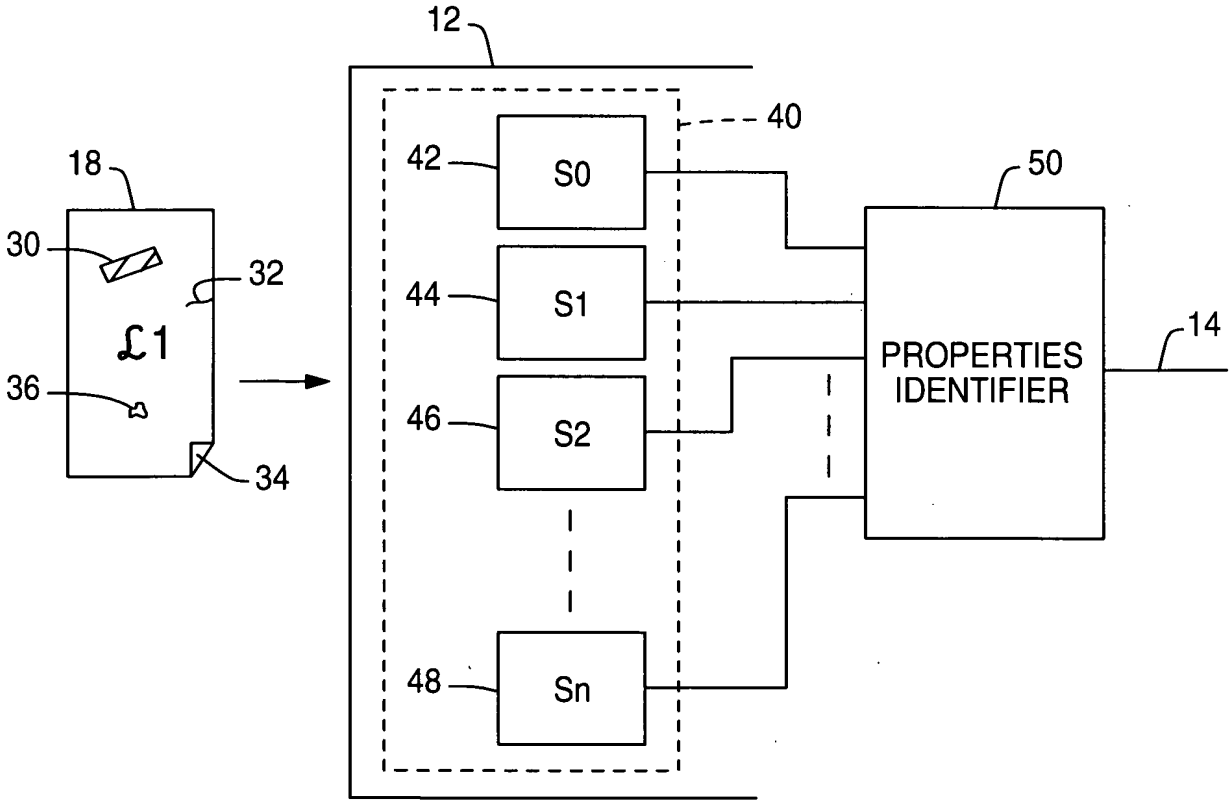

10
12
16
18
14
20
SENSING MODULE
EVALUATION MODULE

FIG. 2


12
40
18
42
S0
50
30
32
44
S1
£1
PROPERTIES IDENTIFIER
14
36
46
S2
34
48
Sn

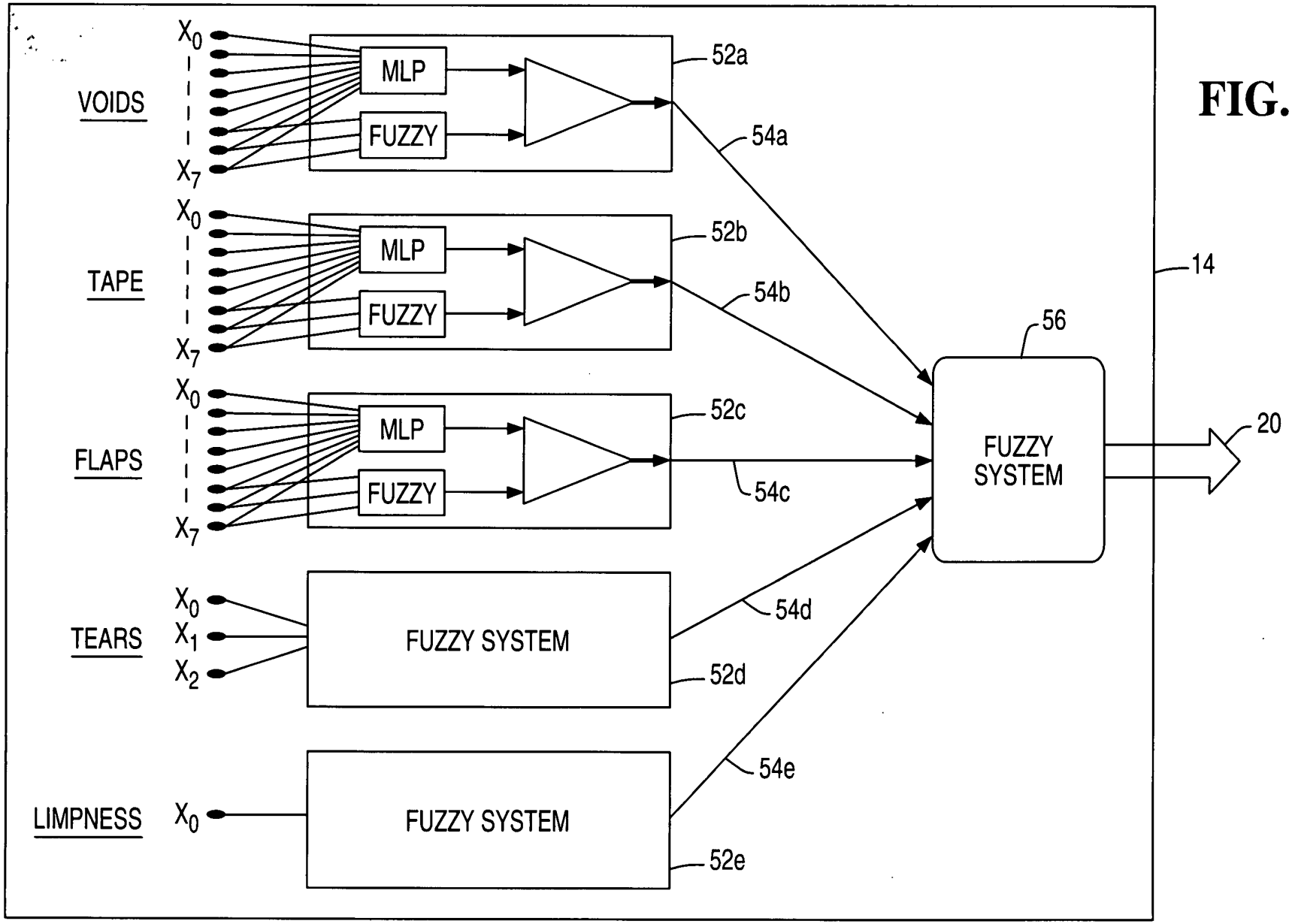

VOIDS
TAPE
FLAPS
TEARS
LIMPNESS
X_0
X_7
X_1
X_2
MLP
FUZZY
FUZZY SYSTEM
52a
52b
52c
52d
52e
54a
54b
54c
54d
54e
56
14
20

FIG. 3

FIG. 4

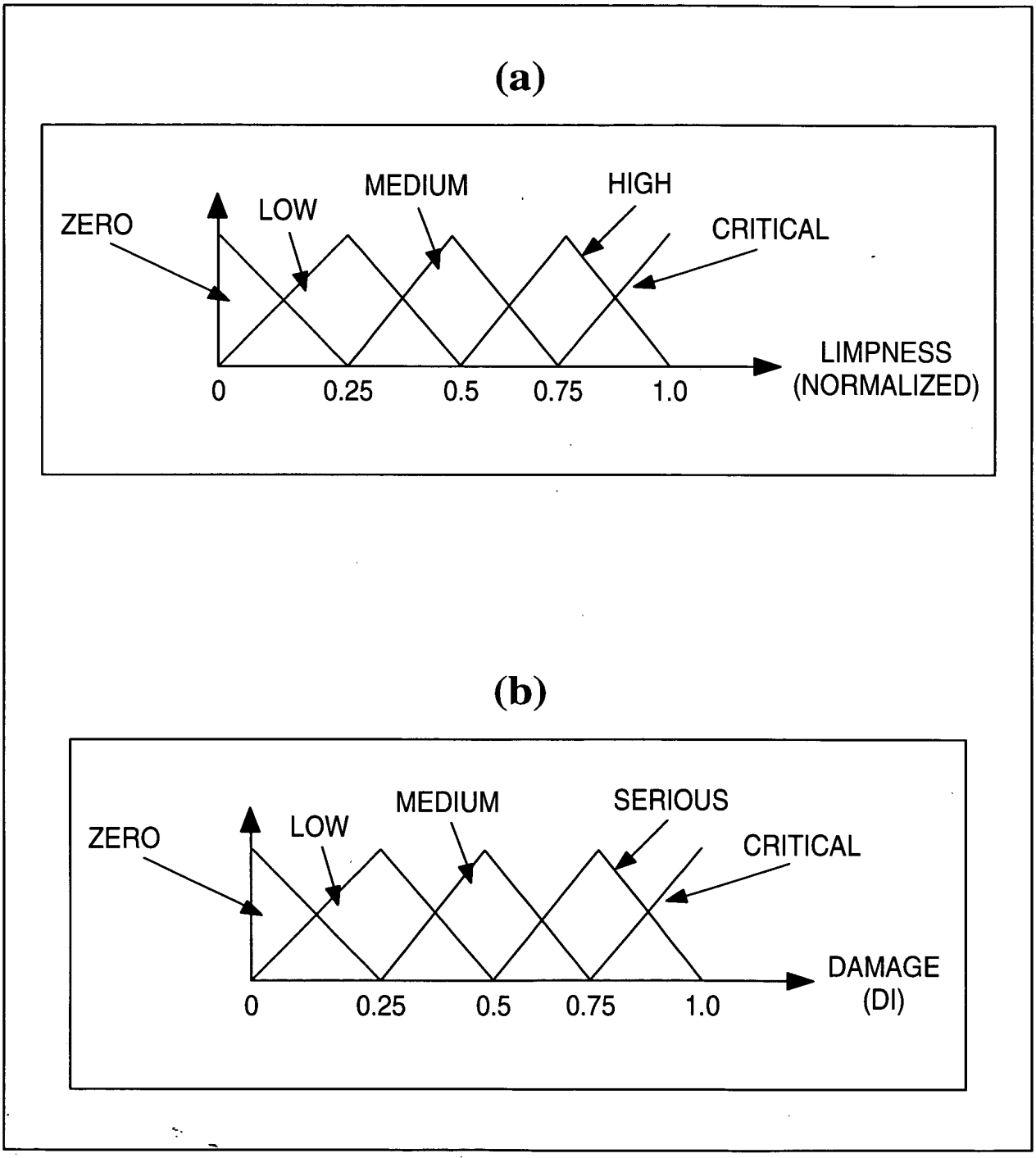

(a)
ZERO
LOW
MEDIUM
HIGH
CRITICAL
LIMPNESS
(NORMALIZED)
0
0.25
0.5
0.75
1.0
(b)
ZERO
LOW
MEDIUM
SERIOUS
CRITICAL
DAMAGE
(DI)
0
0.25
0.5
0.75
1.0

FIG. 5

ANTECEDENT	CONSEQUENT	CF	W
IF LIMPNESS IS ZERO THEN	DI IS ZERO	1.0	0.0
IF LIMPNESS LOW THEN	DI IS LOW	1.0	0.2
IF LIMPNESS MEDIUM THEN	DI IS HIGH	1.0	0.7
IF LIMPNESS HIGH THEN	DI IS HIGH	0.4	0.9
IF LIMPNESS HIGH THEN	DI IS CRITICAL	0.6	
IF LIMPNESS CRITICAL	DI IS CRITICAL	1.0	1.0

CF = CONFIDENCE FACTOR AND W = WEIGHT

FIG. 6

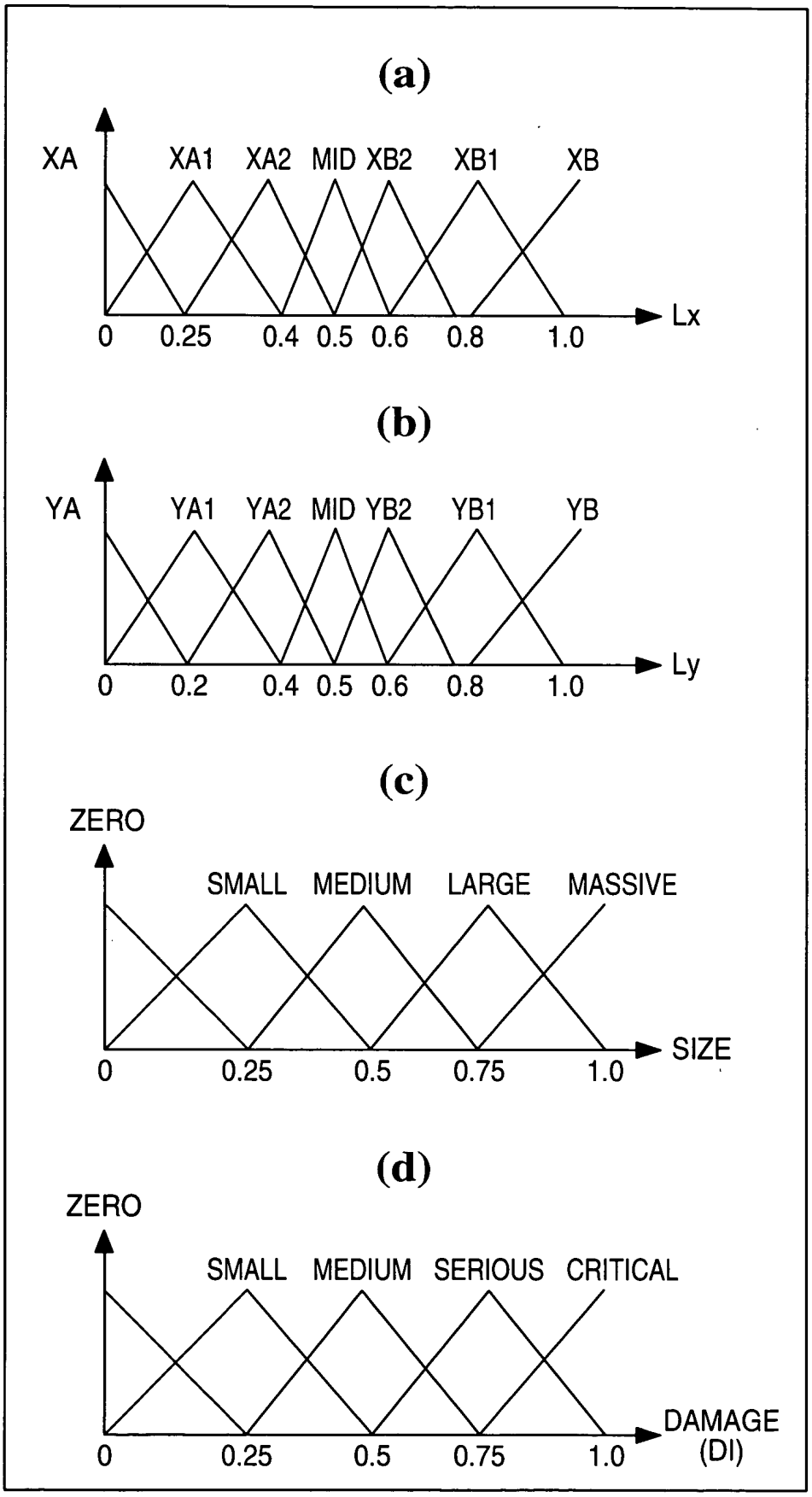

(a)
XA
XA1
XA2
MID
XB2
XB1
XB
Lx
0
0.25
0.4
0.5
0.6
0.8
1.0
(b)
YA
YA1
YA2
MID
YB2
YB1
YB
Ly
0
0.2
0.4
0.5
0.6
0.8
1.0
(c)
ZERO
SMALL
MEDIUM
LARGE
MASSIVE
SIZE
0
0.25
0.5
0.75
1.0
(d)
ZERO
SMALL
MEDIUM
SERIOUS
CRITICAL
DAMAGE
(DI)
0
0.25
0.5
0.75
1.0

FIG. 7

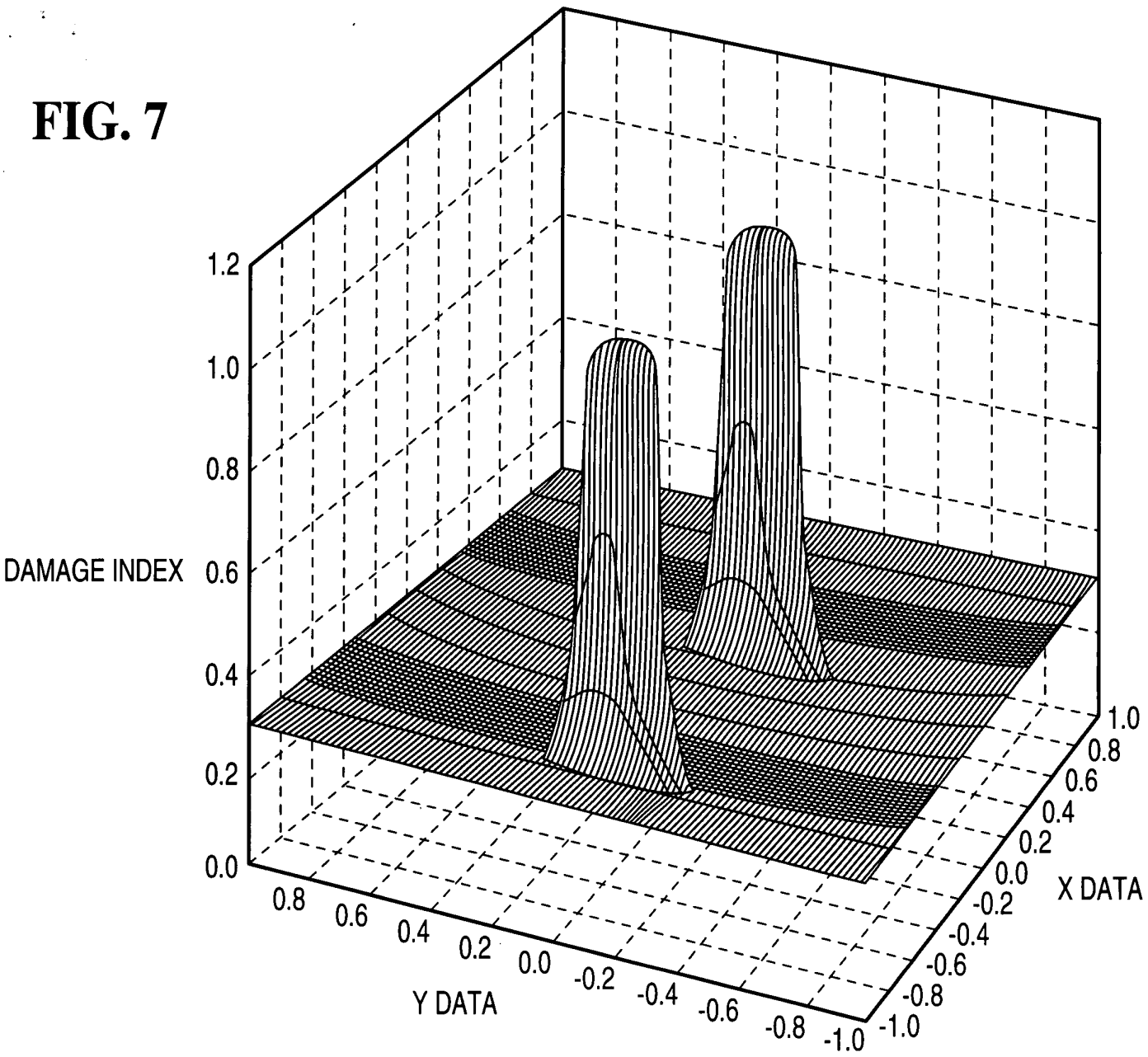

DAMAGE INDEX
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
Y DATA
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
X DATA

FIG. 8

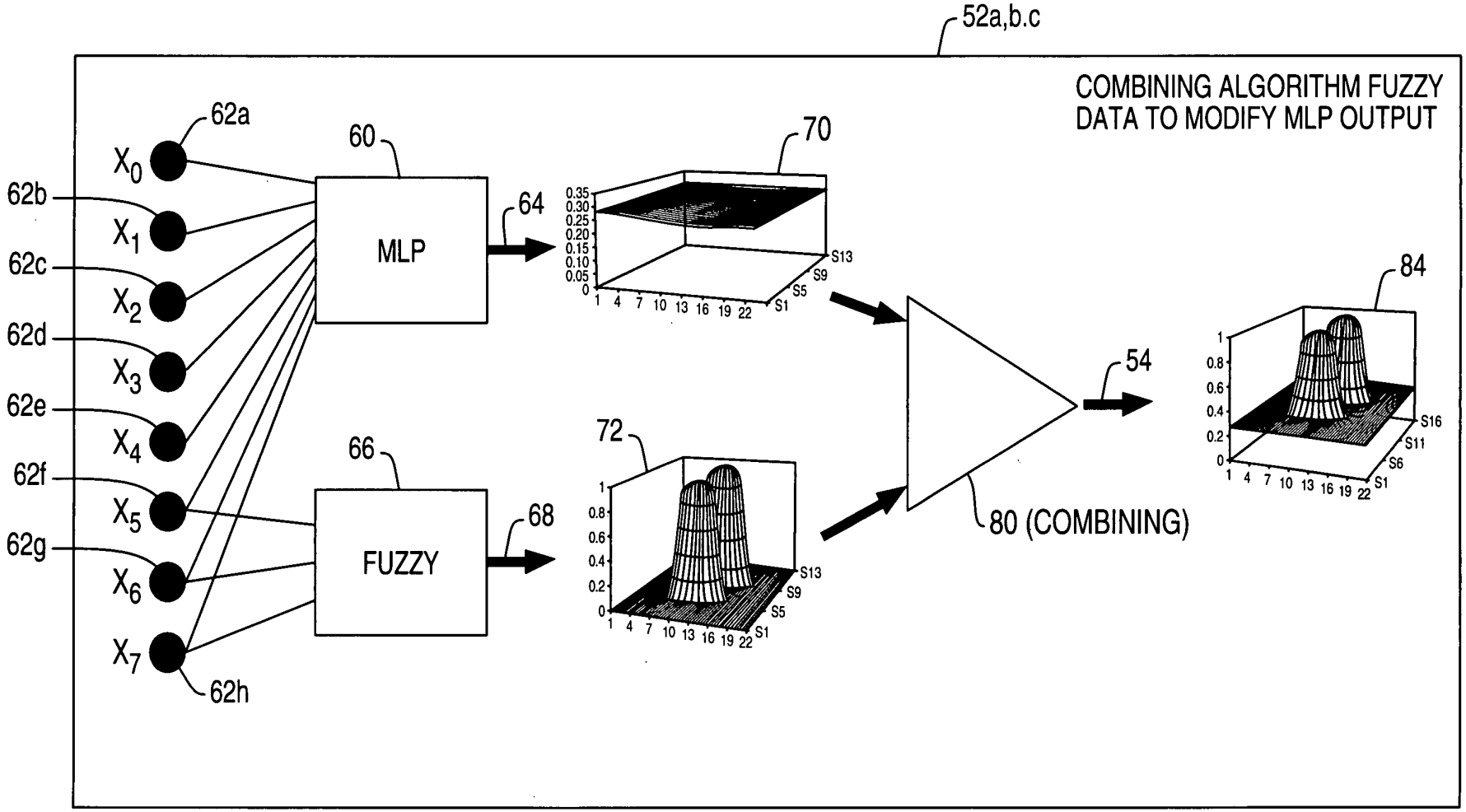

52a,b.c
COMBINING ALGORITHM FUZZY
DATA TO MODIFY MLP OUTPUT
62a
60
70
X_0
62b
X_1
62c
X_2
62d
X_3
62e
X_4
62f
X_5
62g
X_6
X_7
62h
MLP
64
66
FUZZY
68
72
54
84
80 (COMBINING)
S1
S5
S9
S13
S6
S11
S16

FIG. 9

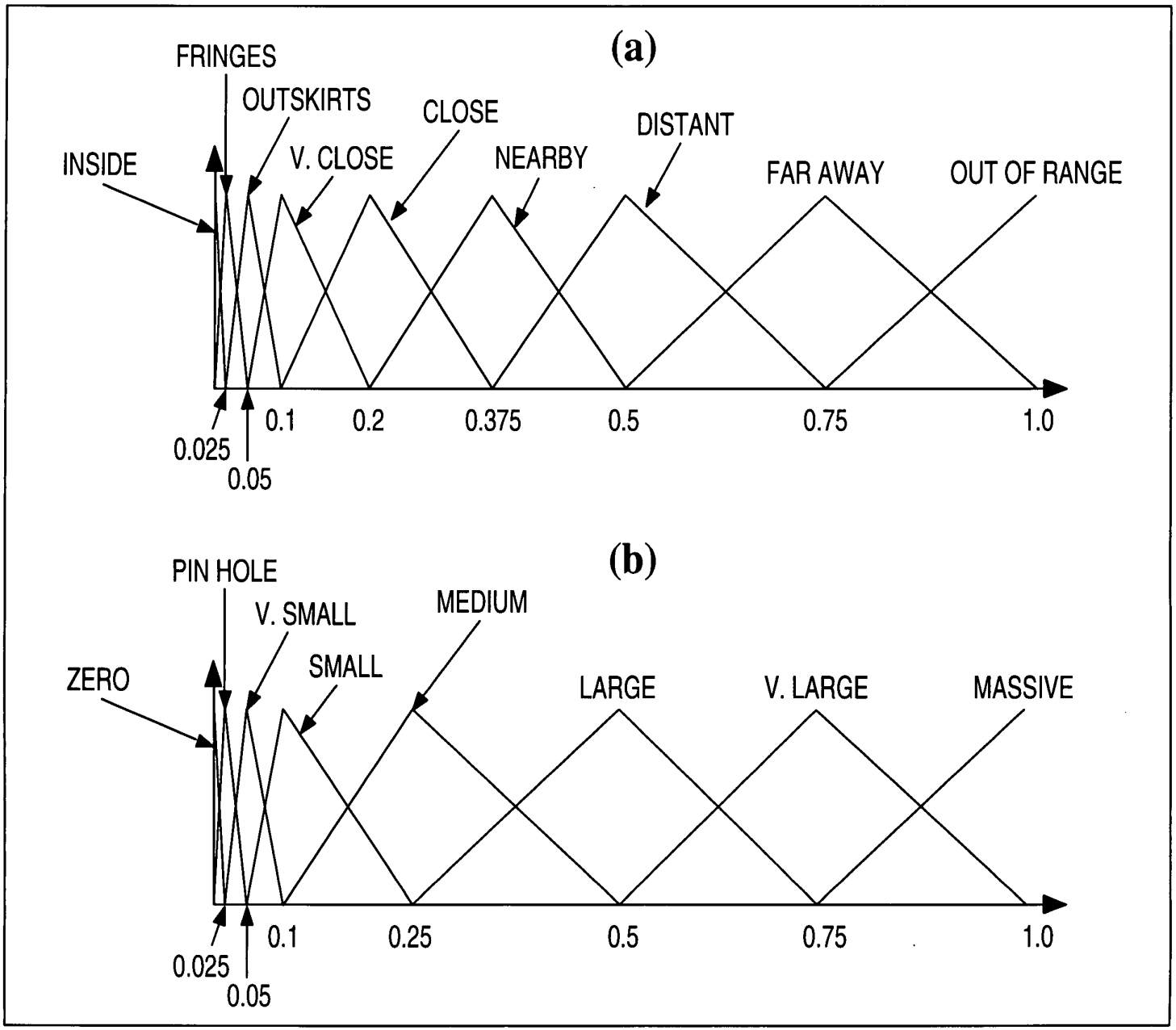

(a)
FRINGES
OUTSKIRTS
CLOSE
DISTANT
INSIDE
V. CLOSE
NEARBY
FAR AWAY
OUT OF RANGE
0.1
0.2
0.375
0.5
0.75
1.0
0.025
0.05
(b)
PIN HOLE
V. SMALL
MEDIUM
SMALL
ZERO
LARGE
V. LARGE
MASSIVE
0.1
0.25
0.5
0.75
1.0
0.025
0.05

FIG. 10

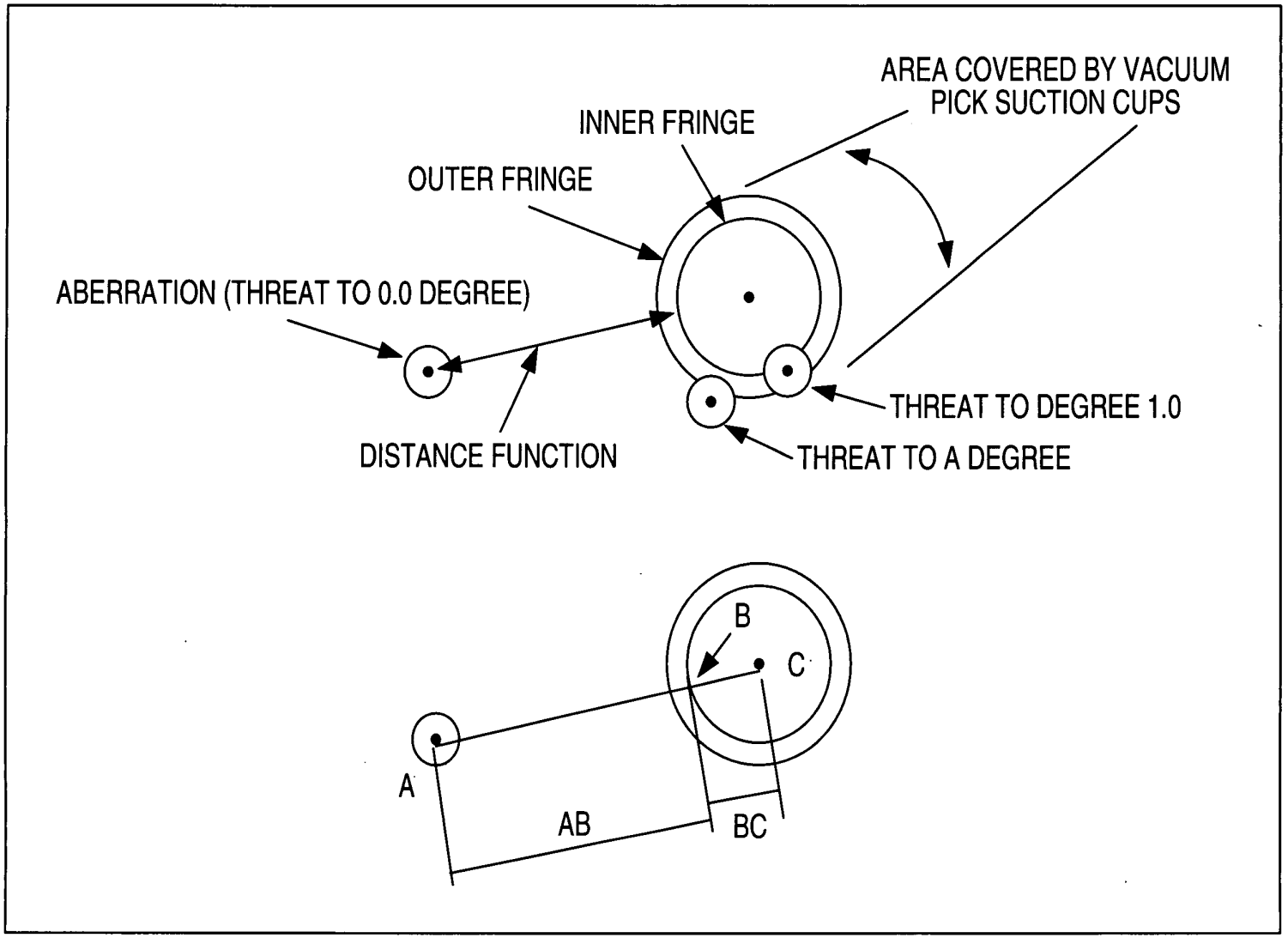

AREA COVERED BY VACUUM PICK SUCTION CUPS
INNER FRINGE
OUTER FRINGE
ABERRATION (THREAT TO 0.0 DEGREE)
THREAT TO DEGREE 1.0
DISTANCE FUNCTION
THREAT TO A DEGREE
B
C
A
AB
BC

FIG. 11

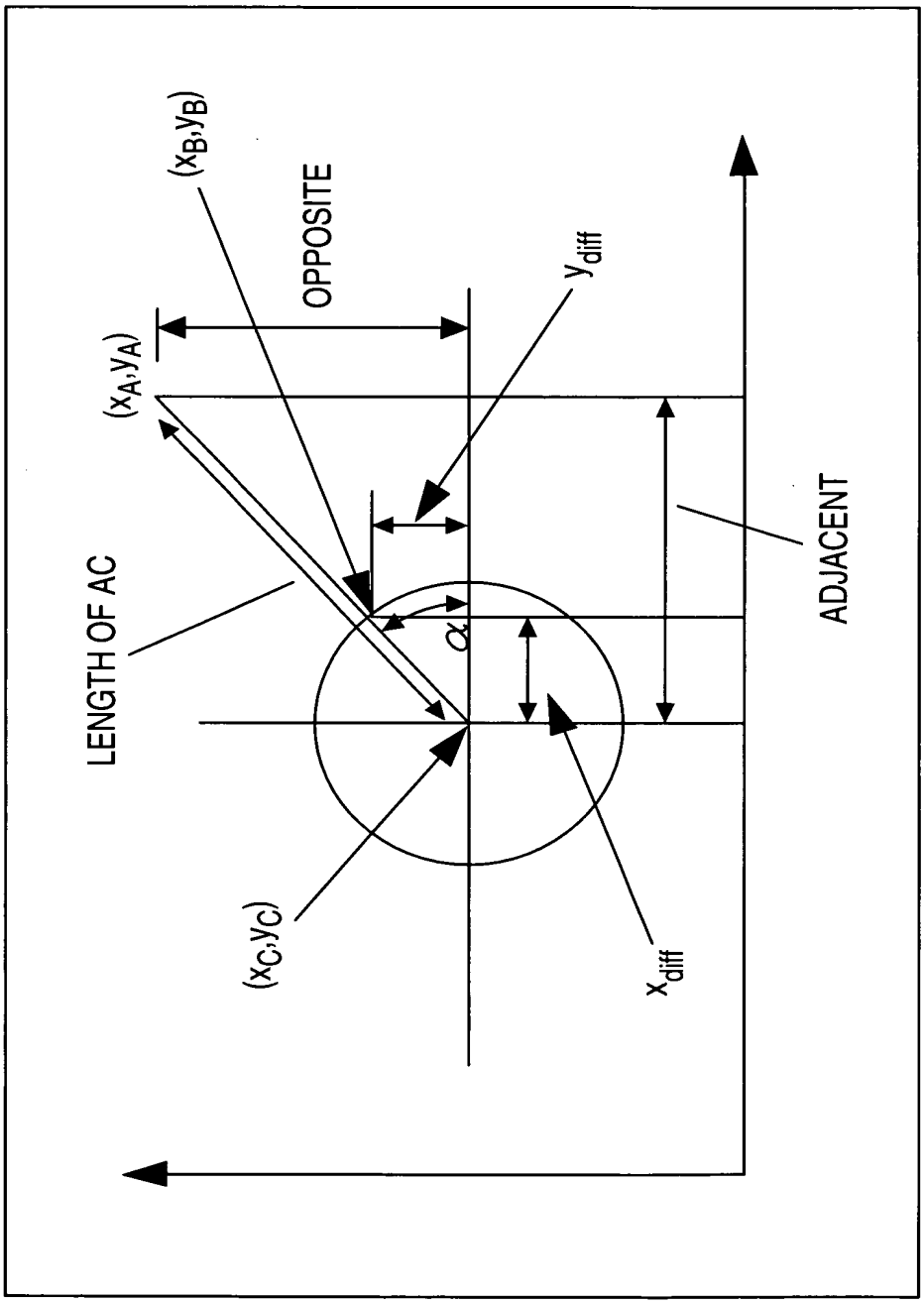

(x_B,y_B)
OPPOSITE
y_{diff}
(x_A,y_A)
LENGTH OF AC
α
ADJACENT
(x_C,y_C)
x_{diff}

FIG. 12

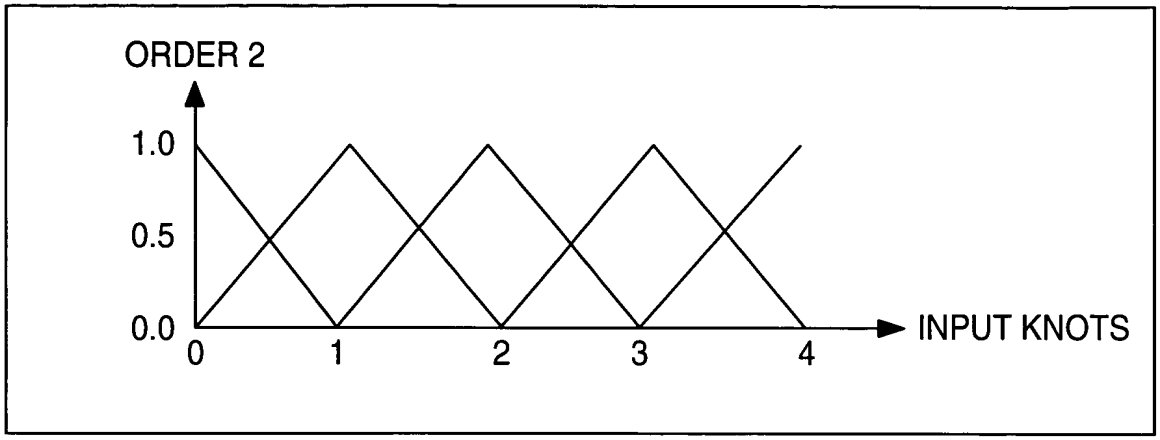


FIG. 13

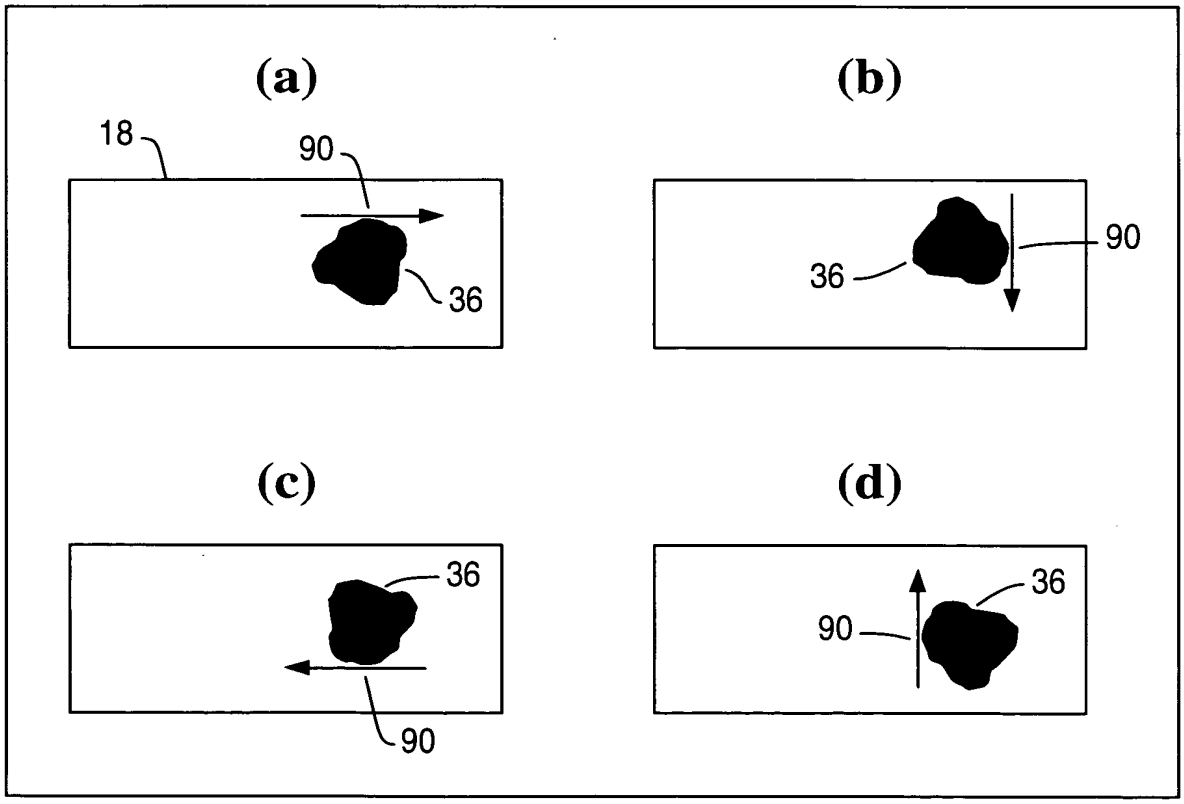


FIG. 14

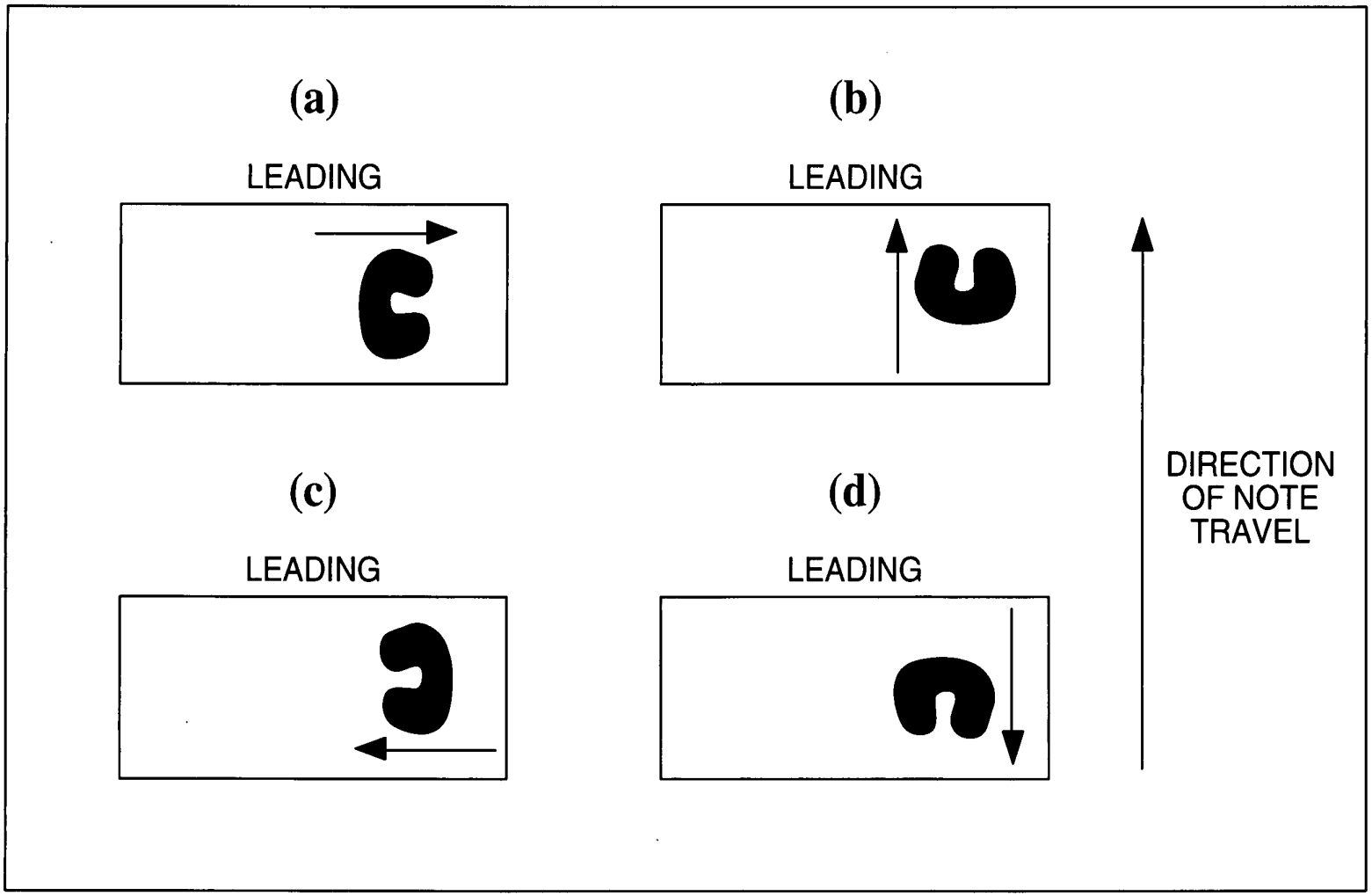

(a)
LEADING
(b)
LEADING
(c)
LEADING
(d)
LEADING
DIRECTION OF NOTE TRAVEL

FIG. 15

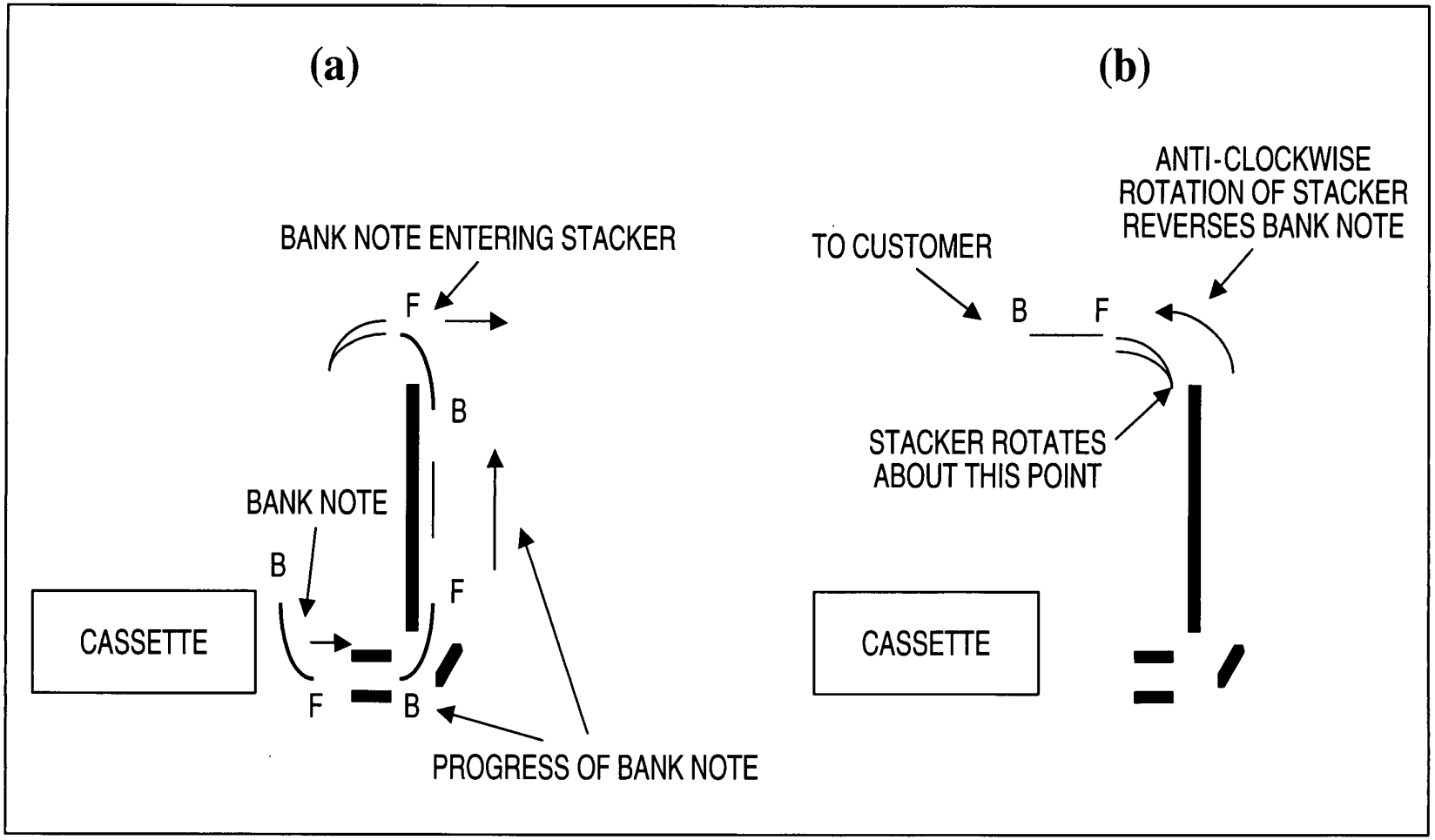

(a)
(b)
BANK NOTE ENTERING STACKER
F
B
BANK NOTE
B
F
CASSETTE
F
B
PROGRESS OF BANK NOTE
TO CUSTOMER
ANTI-CLOCKWISE
ROTATION OF STACKER
REVERSES BANK NOTE
B
F
STACKER ROTATES
ABOUT THIS POINT
CASSETTE

FIG. 16

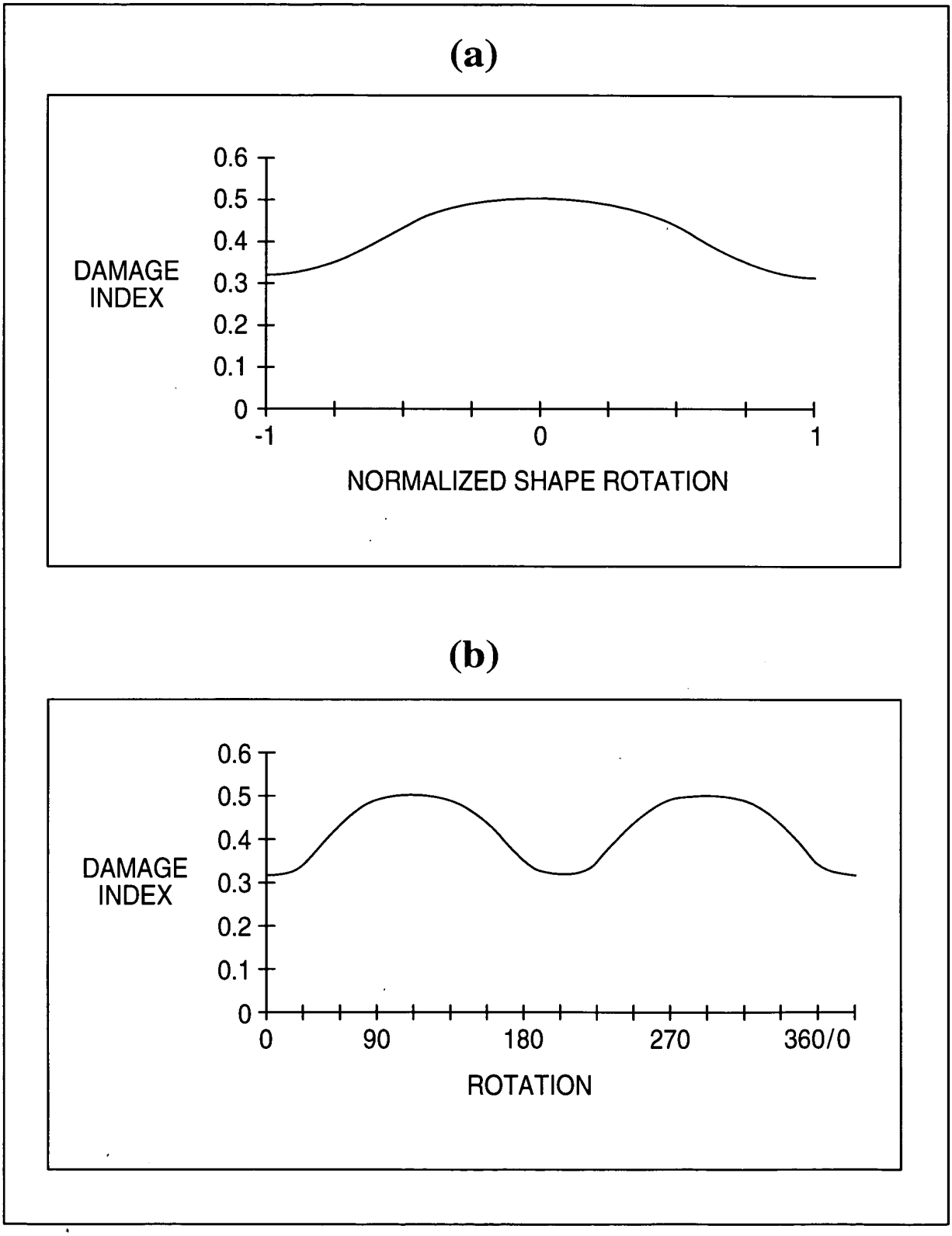

(a)
DAMAGE INDEX
0.6
0.5
0.4
0.3
0.2
0.1
0
-1
0
1
NORMALIZED SHAPE ROTATION
(b)
DAMAGE INDEX
0.6
0.5
0.4
0.3
0.2
0.1
0
0
90
180
270
360/0
ROTATION

FIG. 17

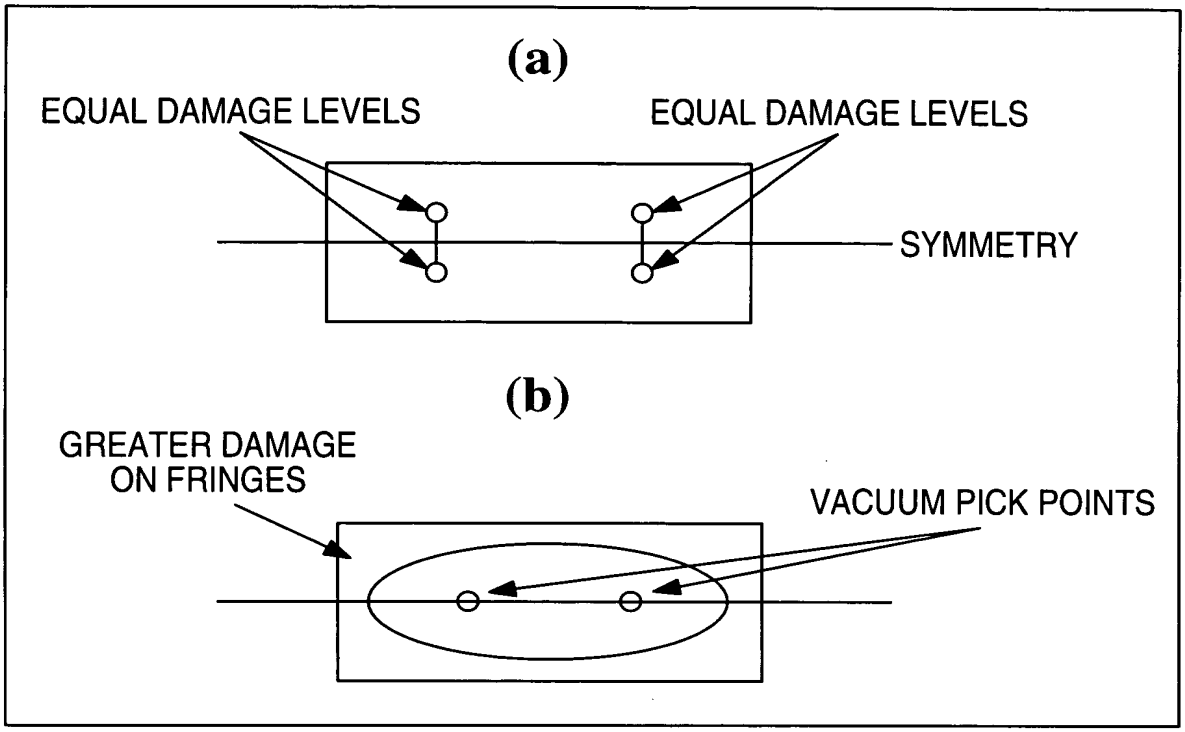

(a)
EQUAL DAMAGE LEVELS
EQUAL DAMAGE LEVELS
SYMMETRY
(b)
GREATER DAMAGE ON FRINGES
VACUUM PICK POINTS

FIG. 18

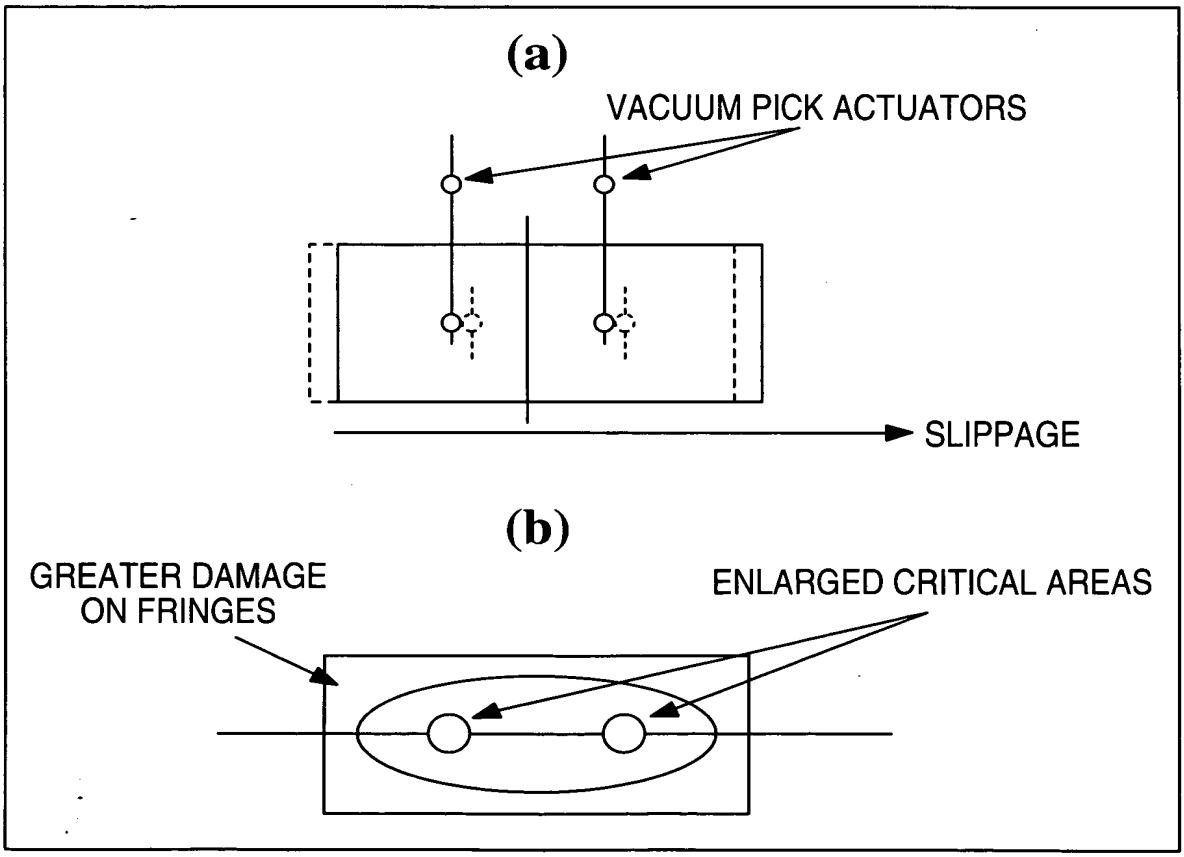

(a)
VACUUM PICK ACTUATORS
SLIPPAGE
(b)
GREATER DAMAGE ON FRINGES
ENLARGED CRITICAL AREAS

FIG. 19

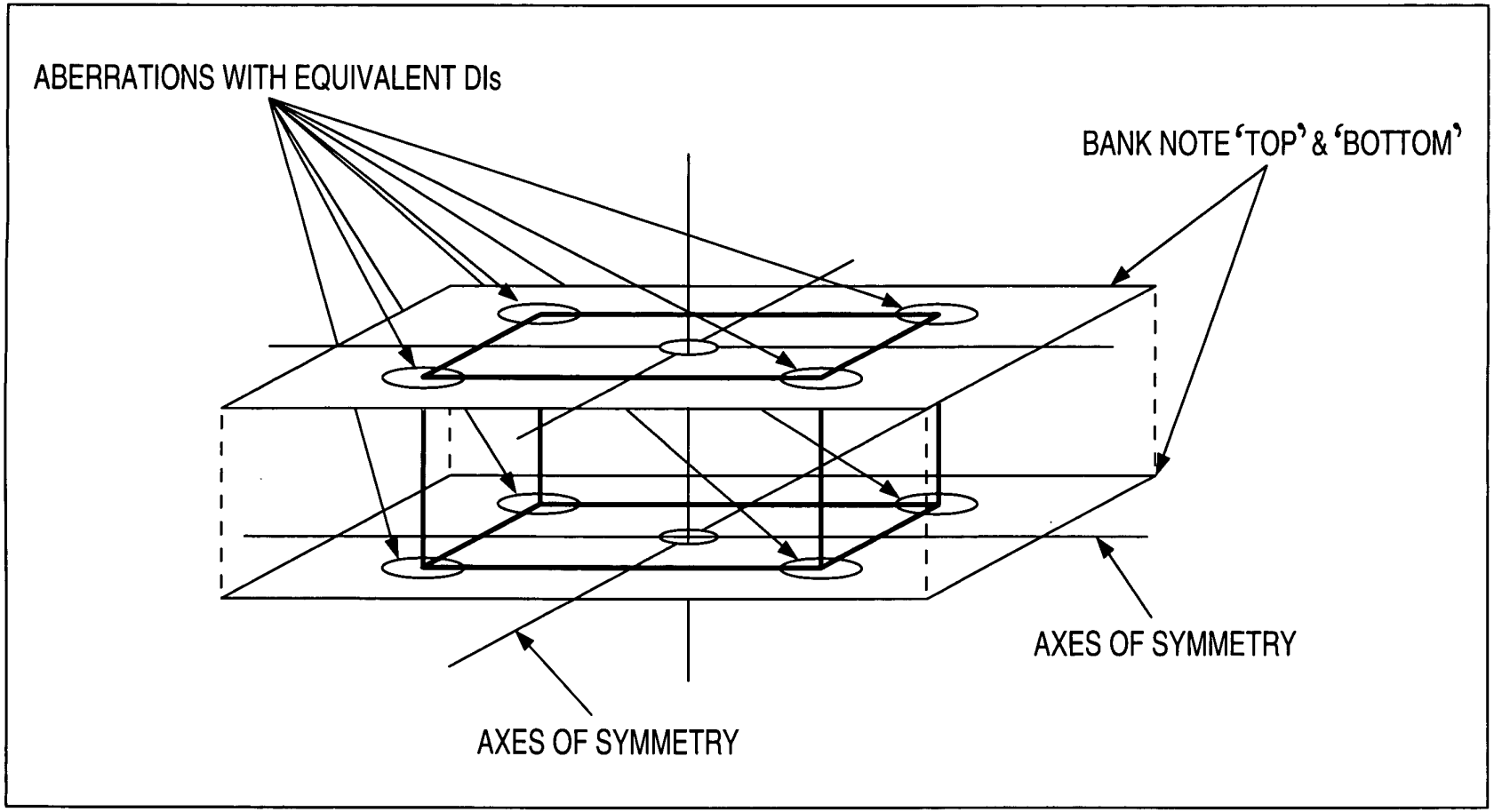
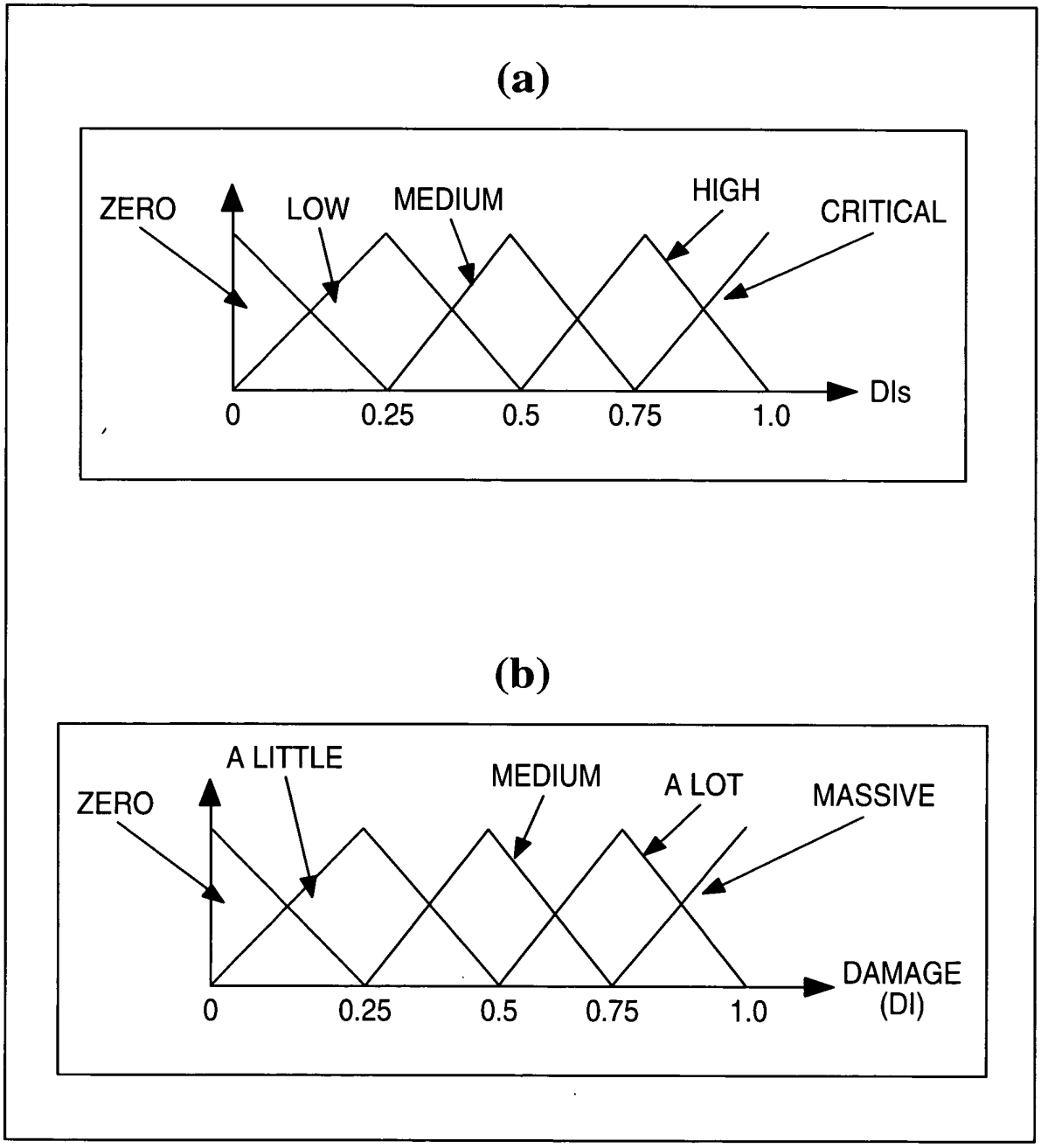

ABERRATIONS WITH EQUIVALENT DIs
BANK NOTE 'TOP' & 'BOTTOM'
AXES OF SYMMETRY
AXES OF SYMMETRY

FIG. 20


(a)
ZERO
LOW
MEDIUM
HIGH
CRITICAL
0
0.25
0.5
0.75
1.0
DIs
(b)
ZERO
A LITTLE
MEDIUM
A LOT
MASSIVE
0
0.25
0.5
0.75
1.0
DAMAGE
(DI)